Prospective Study of British Physicians. The original articles of Doll and Hill contain important details which have been omitted from the 1967 document. Table 5 has grouped all amounts of cigarette smoking, whereas the original articles have specified the quantity from 1 to 14, 15 to 24 and 25+ cigarettes. "There is no clear gradient with number of cigarettes smoked" quoting from (25, 26) Doll and Hill.

Alternatively, cigarette smoking and coronary thrombosis may be related to one another only indirectly through some other factor. It may be, for example, that men with a raised serum cholesterol or of a particular physical constitution (Seltzer, 1963) or who tend to take little physical exercise also tend to take up cigarette smoking, and that these factors contribute to the production of the disease. Such a hypothesis is not, at first sight, unattractive, since the ratio of the mortality rate of smokers to non-smokers is relatively small. But it becomes difficult to accept when all the evidence is taken into account—namely, the much closer relationship at young ages, the increase in mortality with increased amount smoked, the difference between cigarette and pipe smoking and between inhaling and not inhaling, the reduction in mortality with increasing time after smoking has been stopped, and the many physiological effects of smoking on the cardiovascular system. In short, that cigarette smoking is a cause of coronary thrombosis is not, we think, proved; but it is the most reasonable interpretation of the available facts.

In short, we would conclude from these data that the only cardiovascular cause of mortality to show any association with smoking habits is coronary disease, unrelated to hypertension, and that even here the differences in rates are not very marked. The death rate of all smokers (*4.03*) is 23% higher than that of non-smokers (*3.31*), and this excess appears to be limited to the cigarette smokers (*4.39*, or 33% above the non-smokers, Table 18). There is certainly no clear gradient with number of cigarettes smoked, but the highest mortality is found among the heaviest smokers and there appears to be a fall in mortality on giving up smoking (Table 19). We examine these findings more closely in Table 20, which shows the age-specific death rates from coronary disease. These figures show that a rising gradient of mortality from non-smokers to heavy cigarette smokers is clearly present at ages under 65, doubtful at ages 65–74, and absent at age 75 years and over.

We have not sought clinical information about the large number of deaths in this cardiovascular group and consequently have not felt justified in trying to separate a group of deaths which might be ascribed to "cor pulmonale." We noted earlier that 55 cardiovascular deaths included a reference to chronic bronchitis on the death certificate (coronary thrombosis 24, myocardial degeneration 15, hypertension 2, other heart disease 4, and cerebrovascular accidents 10), and it was shown in Tables 16 and 17 that these deaths were closely associated with smoking. It is possible that in a few of them the primary cause was really chronic bronchitis—particularly perhaps among those attributed to myocardial degeneration or "other heart disease"—and that these constitute another cardiovascular group which is also associated with smoking. On the evidence available, however, this group would not appear to be large enough to have materially affected the results. Possibly most such deaths among doctors are attributed directly to chronic bronchitis.

TABLE 18.—*Standardized Death Rates from Cardiovascular Diseases*

Cause of Death		No. of Deaths	Death Rate per 1,000					
			All Men	Non-smokers	All Smokers	Cigarette Smokers	Mixed Smokers	Pipe or Cigar Smokers
Cerebrovascular accidents	(a)*	462	1·39	1·26	1·41	1·43	1·27	1·44
	(b)†	143	0·45	0·51	0·44	0·50	0·41	0·23
	All	605	1·84	1·76	1·85	1·93	1·71	1·67
Coronary disease	(a)*	1,287	3·97	3·31	4·05	4·39	3·87	3·15
	(b)†	89	0·29	0·30	0·33	0·36	0·37	0·21
	All	1,376	4·26	3·61	4·38	4·65	4·25	3·39
Myocardial degeneration		337	0·97	0·59	1·02	1·01	0·95	1·00
Hypertension		133	0·42	0·45	0·42	0·45	0·35	0·37
Other heart disease		135	0·41	0·41	0·41	0·42	0·43	0·33
Other cardiovascular diseases		135	0·41	0·41	0·41	0·45	0·38	0·35
Nephritis		43	0·13	0·09	0·14	0·14	0·13	0·12
Total		2,769	8·44	7·32	8·61	9·11	8·24	7·23
Total hypertensive		370	1·15	1·26	1·14	1·22	1·17	0·81

* (a) Without reference to hypertension on the death certificate.
† (b) Hypertension referred to on the death certificate.

TABLE 19.—*Standardized Death Rates from Cardiovascular Diseases in Relation to the Number of Cigarettes Smoked*

Cause of Death		Death Rate per 1,000				
		No. of Cigarettes Smoked Daily				Given Up Smoking Cigarettes
		1–14	15–24	25+	All Amounts	
Cerebrovascular accidents	(a)*	1·46	1·43	1·63	1·49	1·42
	(b)†	0·46	0·48	0·54	0·51	0·51
	All	1·93	1·91	2·23	2·00	1·93
Coronary disease	(a)*	4·35	4·28	4·97	4·57	3·73
	(b)†	0·29	0·29	0·18	0·28	0·19
	All	4·65	4·57	5·16	4·86	3·92
Myocardial degeneration		1·10	0·94	0·97	1·07	0·67
Hypertension		0·44	0·45	0·45	0·44	0·40
Other heart diseases		0·32	0·39	0·21	0·41	0·41
Other cardiovascular diseases		0·41	0·45	0·42	0·54	0·25
Nephritis		0·16	0·14	0·29	0·17	0·09
Total		9·03	9·05	9·93	9·51	7·86
Total hypertensive		1·20	1·22	1·17	1·25	1·10

* (a) Without reference to hypertension on the death certificate.
† (b) Hypertension referred to on the death certificate.

TABLE 20.—*Death Rate from Coronary Thrombosis by Age**

Age in Years	No. of Deaths	Death Rate per 1,000				
		Non-smokers	Current Cigarette Smokers Smoking Daily			All Cigarette Smokers, Ex and Current
			1–14	15–24	25+	
35–44	36	0·11	0·41	0·49	1·50	0·61
45–54	149	1·12	1·95	3·43	2·73	2·61
55–64	319	4·01	6·41	7·03	8·41	7·20
65–74	369	10·83	16·44	13·04	17·59	14·69
75–84	314	21·20	21·22	15·34	17·20	19·15
85+	78	32·35	31·06	36·54	—†	35·05
All ages	1,267	3·31	4·36	4·28	4·97	4·30

* Includes all deaths attributed to coronary thrombosis, except those for which hypertension was mentioned as a contributory cause (V).
† Very small total number of man years at risk (27)—no deaths due to coronary thrombosis.

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An analysis was made by Schor (*86*) of 181 adult males who died from coronary heart disease generally less than 2 years after receiving a periodic health examination. The results of this study and those of Doll and Hill suggest that sudden death from previously undetected coronary heart disease frequently occurs among cigarette smokers. If this is true, it may, in part, account for the small differentials in the prevalence of coronary heart disease between smokers and nonsmokers observed in some morbidity prevalence surveys. As will be described in the following section, longitudinal, prospective morbidity studies also show that smokers are more likely to die from sudden attacks of coronary heart disease.

Coronary Heart Disease Morbidity*

In chapter 11 of the 1964 Surgeon General's Report, several prospective studies on the incidence of coronary heart disease (*24, 31, 78, 88*) established that smokers were subject to higher rates than nonsmokers. The relationship was reported to be more marked under 50 years of age than among older persons and appeared to be associated with myocardial infarction but not with angina pectoris. Since the 1964 report, recent findings from large-scale, on-going prospective studies have been reported, providing additional insight on the interaction between smoking and other important coronary heart disease risk factors. Current findings are summarized in the following pages including tables 7 to 13. Whenever possible, data are shown separately for findings related to angina pectoris and those pertaining to myocardial infarction, including sudden death attributed to coronary heart disease. Higgins (*50*) has drawn attention to the fact that "many factors may influence or be affected by smoking habits, and obscure those differences between smokers and nonsmokers which are directly related to the use of tobacco." In her review of the literature, Higgins identified differences between smokers and nonsmokers in genetically determined qualities (*23*), in physique (*77, 93*), in personality (*37, 47, 48, 65, 68, 69*), and in social, cultural, religious, and economic characteristics (*40, 49, 68, 84*).

*Also may include mortality data in this presentation.

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